CLAIMS

1. Ionizing radiation imaging apparatus including:

a scintillator element which emits optical radiation as a result of absorption of ionizing radiation; and

a photoconductive multilayer element optically coupled to said scintillator element, said photoconductive multilayer element including:

a charge generation layer which is sensitive to the optical radiation emitted by said scintillator element; and

a charge transport layer disposed over said charge generation layer, said charge transport layer being operative to retain a charge pattern corresponding to said ionizing radiation

2. Ionizing radiation imaging apparatus according to claim 1 and also including a conductive layer, forming a plurality of elongate electrodes, disposed intermediate said scintillator element and said photoconductive multilayer element.

3. Ionizing radiation imaging apparatus according to claim 2 and also including readout electronics coupled to said plurality of elongate electrodes.

4. Ionizing radiation imaging apparatus according to claim 2 and also including an optically transparent blocking layer disposed intermediate said photoconductive multilayer element and said conductive layer, wherein said optically transparent blocking layer is operative to block charges of at least one polarity from being injected into said photoconductive multilayer element from said conductive layer.

5. Ionizing radiation sensitive apparatus according to claim 1 and wherein said charge transport layer is also operative to convert ionizing radiation to charge carriers.

6. Ionizing radiation sensitive apparatus according to claim 1 and wherein said photoconductive multilayer element also includes an optical radiation blocking layer overlying said charge transport layer.

7. Ionizing radiation sensitive apparatus according to claim 1 and wherein said scintillator element is formed on a generally optically reflecting substrate.

8. Ionizing radiation sensitive apparatus according to claim 1 and wherein said scintillator element is formed on a generally optically absorbing substrate.

9. Ionizing radiation sensitive apparatus according to claim 1 and wherein said scintillator element includes cesium iodide doped with thallium.

10. Ionizing radiation sensitive apparatus according to claim 1 and wherein said charge generation layer is formed of arsenic triselenide.

11. Ionizing radiation sensitive apparatus according to claim 1 and wherein said charge generation layer is formed of a selenium-tellerium-arsenic alloy.

12. Ionizing radiation sensitive apparatus according to claim 1 and wherein said charge transport layer is formed of amorphous selenium doped with either arsenic or chlorine or a combination thereof.

13. Ionizing radiation sensitive apparatus according to claim 1 and wherein said charge transport layer is formed of an organic material.

14. Ionizing radiation sensitive apparatus according to claim 6 and wherein said optical radiation blocking layer is formed of amorphous alkali-doped selenium.

15. Ionizing radiation sensitive apparatus according to claim 1 and wherein said scintillator element includes a planarization layer.

16. Ionizing radiation sensitive apparatus according to claim 1 and wherein said ionizing radiation is X-ray radiation.

17. An ionizing radiation imaging sensor including:

a first conversion element that is operative to convert imaging ionizing radiation to optical radiation;

a second conversion element that is operative to convert said optical radiation to a charge pattern corresponding to said imaging ionizing radiation;

a charge source operative at generally atmospheric pressure to provide non-contact charge injection onto said second conversion element thus causing said charge pattern to be sensed.

18. An ionizing radiation imaging sensor according to claim 17 above wherein said second conversion element is further operative to directly convert ionizing radiation to electrical charges.

19. An ionizing radiation imaging sensor according to claim 17 and wherein said ionizing radiation is X-ray radiation.

20. An ionizing radiation image sensor comprising:

a photoelectric conversion element having first and second opposing surfaces, wherein said photoelectric conversion element is highly photogeneration-sensitive to optical radiation impinging upon said first surface and relatively photogeneration-insensitive to optical radiation impinging upon said second surface; and

an ionizing radiation sensitive scintillator element optically coupled to said first surface of said photoelectric conversion element.

21. An ionizing radiation image sensor according to claim 20 wherein said second surface of said photoelectric conversion element is highly permeable to ionizing radiation.

22. An ionizing radiation image sensor according to claim 20 wherein said second surface of said photoelectric conversion element is an exposed charge accepting and retaining surface.

23. An ionizing radiation image sensor according to claim 20 wherein said photoelectric conversion element is amorphous selenium based.

24. A charge pattern produced in response to absorption of spatially modulated ionizing radiation and composed of:

charge carriers generated in response to partial absorption of said ionizing radiation; and

charge carriers generated in response to non-ionizing optical radiation emitted in response to further absorption of said ionizing radiation.

25. A charge pattern in accordance with claim 24 and wherein said optical radiation is emitted concurrently with the absorption of said ionizing radiation.

26. A charge pattern in accordance with claim 25 and wherein said optical radiation is emitted through external stimulation subsequent to the absorption of said ionizing radiation.

27. A charge pattern in accordance with claim 24 and wherein said ionizing radiation is X-ray radiation.

28. A method for sensing X-ray images and including:

exposing a sensor to spatially modulated X-ray radiation; and

forming a net charge pattern retained by the sensor, said net charge pattern representing said spatially modulated radiation and being composed of charge

carriers generated in response to partial absorption of said spatially modulated X-ray radiation and charge carriers generated in response to optical radiation emitted within the sensor in response to further absorption of said spatially modulated X-ray radiation.

29. A method for detecting X-ray images including:

exposing an imaging sensor to ionizing radiation;

emitting optical radiation in a scintillator element of said imaging sensor in response to absorption of said ionizing radiation;

photogenerating charge in a charge generation layer of said imaging sensor in response to said optical radiation;

providing transport of said photogenerated charge through a charge transport layer of said imaging sensor thereby creating a net charge pattern at said imaging sensor wherein said net charge pattern generally corresponds to said ionizing radiation;

injecting charge onto said sensor to uniformize said net charge pattern thus yielding measurable charge flow within said sensor; and

detecting said measurable charge flow to provide a digital image representation of said X-ray images.

30. A method for detecting ionizing radiation images including:

providing an imaging sensor;

causing ionizing radiation to impinge on said imaging sensor;

converting said ionizing radiation to optical radiation in said imaging sensor;

converting said optical radiation to a charge pattern at said imaging sensor wherein said charge pattern corresponds to said ionizing radiation; and

providing non-contact injection of charge at generally atmospheric pressure onto said imaging sensor, thus causing said charge pattern to be detected.

31. A method for creating a charge pattern in an imaging sensor in response to ionizing radiation including:

exposing said imaging sensor to ionizing radiation;

emitting optical radiation in a scintillator element of said imaging sensor in response to absorption of said ionizing radiation;

photogenerating charge in a charge generation layer of said imaging sensor in response to said optical radiation; and

providing transport of said charge through a charge transport layer of said imaging sensor therefore creating a net charge pattern at said imaging sensor wherein said net charge pattern generally corresponds to said ionizing radiation.

32. A method for detecting ionizing radiation images including:

exposing said imaging sensor to ionizing radiation;

emitting optical radiation in a scintillator element of said imaging sensor in response to absorption of said ionizing radiation;

photogenerating charge in a charge generation layer of said imaging sensor in response to said optical radiation;

providing transport of said charge through a charge transport layer of said imaging sensor thereby creating a net charge pattern at said imaging sensor wherein said net charge pattern generally corresponds to said ionizing radiation;

uniformizing said charge pattern through injection of charge of either or both polarities into said imaging sensor thus causing currents to flow within said imaging sensor; and

reading out said currents from said imaging sensor to provide a digital image representation corresponding to said charge pattern.

33. A method for detecting ionizing radiation images according to claim 32 and wherein said ionizing radiation is X-ray radiation.